

Dryland Alfalfa for N-Fixation and Labor Savings

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County: Yellowstone

Average annual precip: 13-14"

MLRA: 58A, Northern rolling plains

Dominant Soil Type: Variable; mostly clay and SiCL with some salinity

Acres: 1000 acres over multiple fields in various years of the rotation

Planting Date: Late April to early May

Seeding Rate: 2-3 lb/acre of RR alfalfa

Seed cost: \$6/lb

Seeding Method: Double-disc air drill, no rolling after seeding, drill is calibrated 3 times to ensure accuracy

Row Spacing: 12"

Tillage: No-till

Previous Crop and Year: Winter wheat, 45 bu/acre yield goal

Herbicides: Pre: Glyphosate 12 oz/acre in fall after winter wheat harvest, then 20 oz/acre glyphosate in April prior to alfalfa seeding

Post: Glyphosate in June for cheatgrass and goatgrass, glyphosate in July for broadleaf weeds

Insecticides/Fungicides: Tombstone™ for cutworms if needed at time of seeding

Fertilizer: None applied with the alfalfa seed

Irrigation: Dryland

Termination Date: May of the fourth year when air temp is 70F and alfalfa plants are 8" tall

Termination Method: 4 oz Stinger™+ 14 oz Banvel™+ 12 oz glyphosate

Next Crop: Winter wheat, seeded in Sept after May alfalfa kill



Fig. 1. Dryland alfalfa, Yellowstone County, June 2017. Photo credit: USDA NRCS

Table 1. Monthly precipitation at Billings, MT. Western Regional Climate Center station #240807.

Billings	J	F	M	A	M	J	J	A	S	O	N	D	Total
30 yr avg 1981-2010	0.45	0.36	0.64	1.19	2.09	2.64	1.67	1.19	1.08	0.76	0.50	0.43	13.01
2017	0.63	0.83	2.22	3.34	1.61	2.31	0.13	0.17	2.74	0.49	1.35	1.81	17.63
2018	0.6	1.66	0.7	2.16	5.22	3.94	0.65	1.45	0.78	0.7	0.46	0.69	19.01
2019	0.95	2	0.37	1.98	2.41	2.08	2.08	2.05	3.24	0.84	0.96	0.14	19.1

Introduction: This dryland wheat farmer's goal is to minimize input costs, decrease financial risk, and save labor. The farmer and his wife added 1000 acres of alfalfa to their 8000 acre crop rotation to meet this goal. Their crop rotation is winter wheat – 2 to 5 years of alfalfa – winter wheat – malt barley or spring wheat. Prior to trying alfalfa, they tried corn, sunflowers, Willow Creek winter wheat for hay, and annual mixed cover crops, but were not happy with the economic returns. Dryland alfalfa has helped them reduce their total N fertilizer purchase for the farm by 40%, saving money on their most expensive input cost. It has also reduced their labor requirements and improved soil health. Winter wheat is fertilized for a 45 bu/acre yield goal to minimize risk. If weather conditions are dry, fertilizer will not be wasted. If weather conditions are wet, additional N can be top-dressed in the spring.

Method: Alfalfa is seeded in the spring after winter wheat is harvested with a stripper header the previous summer. Seeding rate is 2-3 lb/acre with Roundup Ready seed. No cutting is taken during the first year of alfalfa growth. One cutting is taken in the second year and again in the third year around the end of June or first of July. Alfalfa yields range from 1.5-3 ton/acre, depending on weather. The alfalfa is terminated the spring of the fourth year, and winter



wheat is planted again that fall. Winter wheat following alfalfa often does not need N fertilizer, due to adequate N reserve in the soil. Alfalfa harvest is contracted out to neighbors, with all hay sold locally. The farm does not have the expense of owning and maintaining haying equipment. Also, the labor flexibility provided by not having to harvest the alfalfa fields is valuable given there are only 2 full-time workers on the farm.

Results:

- Decreased total purchase of N fertilizer by 40%, which is the top input cost on the farm.
- Zero N fertilizer needed for 45 bu/acre winter wheat yield goal following alfalfa, due to 68 lb N/acre soil test and 40 lb N/acre credit from decaying alfalfa roots. Some fields have tested up to 136 lb N/acre in top 2 feet of soil following alfalfa termination.
- Winter wheat following alfalfa with zero N fertilizer applied had 16% protein and about 4-5 bu/ac less yield than fertilized field without alfalfa in the rotation.
- Profit per acre of alfalfa is equal to or greater than winter wheat profit (based on 2019 market prices).
- Reduced N fertilizer application slows soil acidification on dryland soils.
- Decreased labor needs and equipment costs by contracting out the alfalfa haying operation.
- Decreased wear and tear on the grain combine, with 1000 less acres to harvest each year.
- Rotational flexibility. Alfalfa stays in for 2 to 5 years, depending on markets and weather. Nitrogen benefit to the subsequent wheat crop appears to be the same whether the alfalfa is in for 2 or 5 years.
- Reduction of weed pressure. Winter wheat fields with excessive weeds are put into alfalfa for weed clean-up. The longer the alfalfa is in, the cleaner the fields become.
- Improved soil health.
 - Field with 2 years of alfalfa in rotation had 30% faster infiltration rate than adjacent field with no alfalfa in rotation (Nov 2019).
 - Worms present in soil near alfalfa roots and none detected in field without alfalfa in the rotation.
- Winter wheat is recommended as the best crop to follow alfalfa in this rotation. It has deep roots and a fall growth habit to capture available N and decrease N loss to over-winter leaching.



Fig. 2. Alfalfa roots with nodules, June 2017 (left). Worms associated with dead alfalfa roots (center), and soil porosity at the base of an infiltration ring at 3-inch depth after alfalfa termination (right), Nov 2019. Photo credits: USDA NRCS

Challenges:

- Lack of crop residue following alfalfa termination and prior to winter wheat growth makes soil vulnerable to erosion.
- Soil moisture should be carefully monitored to ensure that alfalfa is not depleting the soil moisture profile. In a dry weather cycle, terminating alfalfa after 2 years may help conserve soil moisture rather than letting it grow for 3 years or more. Lack of soil moisture may decrease the following winter wheat yield. To date, the farm has not had a wheat yield decrease, however the most recent 3 years of annual precipitation have been 4 to 6 inches greater than the 30-year average (Table 1).

